Self-Reported Anatomical Characteristics of the Penis and Male Sexual Function

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Article

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Abstract

Premature ejaculation (PE) and erectile dysfunction (ED), which is common male sexual dysfunctions worldwide, lead to substantial distress in men as well as their partners, and decrease the quality and stability of romantic relationships, and, consequently, lead to a decreased quality of life in a large part of the population.

We investigated the associations between self-reported anatomical characteristics of the penis and PE and ED in an urban Chinese sample.

We recruited 1976 Chinese urban men aged 18 to 50 to fill out an online questionnaire regarding demographic information, anatomical characteristics of the penis, as well as PE and ED.

Participants reported their age, penile length, penile circumference, circumcision status, and foreskin characteristics as well as answered the International Index of Erectile Function-5 (IIEF-5) and Checklist for Early Ejaculation Symptoms (CHEES).

Penile length and girth were associated with less ejaculatory problems, but only penile length was associated with less erectile problems. Results showed that overall higher age was associated with less ejaculatory and erectile problems. This pattern was confirmed in the younger group (age \(\leq 31\)) where higher age was associated with less ejaculatory and erectile problems. However, in the older group (age \(> 31\)), higher age was associated with more ejaculatory and erectile problems. The relationship between penile length and sexual function did not change with age whereas penile girth was associated with less ejaculatory problems in the older age group only. Male circumcision and less foreskin covering the glans penis were associated with less ejaculatory and erectile problems. The present study is the first study to investigate the association between anatomical characteristics of the penis (penis size and circumcision) and sexual function. However, the self-reported measurement of penis size is a potential limitation.

the penis size was measured by self-reported. There is a potential limitation to the reliability of such self-reports. The results indicated that the relationship between the anatomical characteristics of the penis and sexual function was complex. Also, the effects of age on sexual function were positive among younger men and negative among older men.

Introduction

Premature ejaculation (PE) and erectile dysfunction (ED), which cause negative outcomes in men and their partners, are common sexual dysfunctions worldwide. There has been little interest in how the penis and its anatomical features are associated with male sexual function. Therefore, we investigated the associations between self-reported anatomical characteristics of the penis as well as PE and ED. Given that there was reason to believe that age could be associated with how men relate to their sexual anatomy, we also included age in our analyses.
**PE and ED**

Premature ejaculation (PE) is characterized by a lack of control over the timing of ejaculation, a short intravaginal ejaculation latency time (i.e., the time between the start of vaginal penetration to ejaculation), and subsequent sexual distress [1, 2]. On the one hand, PE is associated with lower self-confidence and self-esteem [3, 4], higher anxiety and depression [5], and interpersonal difficulties [6, 7] among men. On the other hand, the partners of men with PE report lower relationship and sexual satisfaction, as well as an increased prevalence of sexual dysfunctions [8]. In a similar vein, a large cross-cultural study found that one in five women reported that they had broken up or divorced men because of ejaculatory problems [9].

Erectile dysfunction (ED) is defined as the inability to attain or maintain an erection sufficient to obtain satisfaction from sexual intercourse [10, 11]. It is associated with low self-esteem and sexual satisfaction [12]. A number of studies have reported that ED is associated with an increased risk of PE [13, 14].

For male sexual function, in the erection phase, the parasympathetic nervous system activates the relaxation of muscles otherwise limiting the flow of blood into the penis. In the ejaculation phase, the sympathetic nervous system facilitates the emission of seminal fluid [15]. There are a few preliminary studies suggesting a role for sympathovagal imbalance in PE, with men with PE displaying higher levels of sympathetic activation than sexually functional controls in both non-aroused [16, 17] and aroused [18] settings. In the case of autonomic imbalance, sympathetic overactivity might inhibit erection and facilitate ejaculation. This may result in insufficient erection and early ejaculation.

**Age and Sexual Dysfunction**

The association between age and sexual function is still not completely understood. Although some previous research has found that older men have longer self-reported ejaculation latency times [8], age has not always been found to be associated with PE [19, 20]. However, previous studies have relatively consistently found that higher age is associated with a higher risk of ED [14, 21], with ED increasing in prevalence, particularly in men aged over 40 [22]. On one hand, more sexual experience as a function of increased age may lead to less sexual performance anxiety (especially within long-term relationships) which in turn might decrease the risk of PE and ED [23]. On the other hand, the higher risk of ED with increased age might also drive an increased risk of PE as PE and ED are positively associated [13, 14].

Interestingly, both cross-sectional and longitudinal studies have shown that testosterone levels decline gradually as men age from their 30s to their 90s [24–26]. Testosterone plays a role in every step of the male sexual response [27] with previous research showing that lower testosterone levels are associated with reduced sexual desire [28] and ED [28, 29]. In addition, testosterone replacement treatment can improve the latency times of men with acquired PE (PE appearing only after a man's first sexual experience) [30]. In a similar vein, another contributing factor is cardiovascular disease contributing to ED with age [31]. Based on the above, we supposed that the association between age and sexual dysfunction may not simply be linear. Instead, the effects of age on sexual function could be positive.
among younger men (due to the psychological effects of increased sexual experience) and negative among older men (due to biological changes caused by aging). Therefore, we investigated the association between age and sexual function among adult men while dividing them into a younger and older age group. Based on the above, we expected that the association between age and sexual function is positive among younger men and negative among older men.

**Penis Size and Sexual Dysfunction**

Penis size is a specific body image-related concern for men. It is also considered a symbol of fertility, masculinity, and dominance [32]. Many men suffer from excessive anxiety and dissatisfaction with their penis size and this includes men with normal penis size [33, 34]. This type of anxiety has been called “small penis anxiety” [35] and it is associated with reduced sexual intercourse satisfaction [34]. In this study, excessive worry and shame concerning penis size (i.e., a kind of body dysmorphic disorder) had a negative effect on erectile function, orgasmic function, and satisfaction with sexual intercourse [34]. Concerns about penis size are one aspect of body image, which has been defined as an individual’s subjective perception of the appearance of their body. Previous research has shown that a generally negative body image is associated with lower sexual satisfaction and sexual functioning [36, 37]. Some studies have also found satisfaction with penis size to be associated with fewer ejaculatory and erectile problems [38, 39]. Therefore, we assumed that excessive anxiety, worry, and shame concerning penis size during sex would trigger an overactive sympathetic nervous system response [40–42] which in turn would disturb the normal erectile and ejaculatory functions.

So far, little research into the connections between penis size and male sexual function has been conducted. Recently, men have started to seek surgical penile augmentation to increase penile length or circumference to change the penile size to a more ideal size, improve sexual function and self-confidence, or because of medical issues [43]. In a study of 30 Chinese men, the increases in penile length and circumference after penile augmentation was found to improve the participants’ sexual self-esteem, satisfaction with the penis [44], as well as ejaculation latency times [45], and erectile function [45, 46]. Although suggestive of a causal effect of penile length on sexual function, these findings may not be generalizable to all men. A study of 1027 Egyptian men found that men with ED had shorter fully stretched penis lengths than men without ED, but no connection between the penile circumference and ED was found [47]. However, a study of 689 Brazilian men did not find the effect of penile length on erectile function [39]. So far, no studies have directly investigated the link between penis size and sexual function in a non-clinical Asian sample. Based on the available evidence, we expected men with longer penises to have less ejaculatory and erectile problems and only conducted analyses regarding girth in an exploratory manner.

**Penile Circumcision and Sexual Dysfunction**

Circumcision of the penis is one of the most common surgical procedures worldwide. The procedure involves the surgical removal of part or all of the foreskin from the penis for, among others, religious, cultural, and medical reasons. Approximately one in three men has been circumcised worldwide [48]. The
foreskin is the double layer of skin that covers the glans penis. Possible roles of the foreskin may include keeping the glans moist [49], protecting the developing penis in the womb [50], and enhancing sexual pleasure due to the presence of nerve receptors [51]. The tight foreskin of the penis glans (i.e., phimosis) may cause erectile problems and even pain during sexual intercourse [52] which is a common medical reason for circumcision.

The effect of penile circumcision on sexual function has been investigated for a long time but remains controversial. Recent reviews indicate that penile circumcision may not have a robust effect on sexual function [53, 54], penile sensitivity [53, 54], sexual pleasure, or specifically PE [55] or ED [56]. However, some recent studies found that circumcised men reported better erectile function and less penile pain at rest and during sex which might be the reason for the improvement of erectile function [52], higher intravaginal ejaculatory latency times and better control over ejaculation and more satisfaction with sexual intercourse compared to themselves before circumcision as well as compared to uncircumcised men [57, 58].

Bossio et al. (2016) found that uncircumcised men’s foreskin sensitivity to tactile stimulation was higher than that of other penile sites (glans penis, proximal to midline shaft of the penis, midline shaft). Further, penile sensitivity was not different between circumcised and uncircumcised men among the latter penile sites [59]. In conclusion, the foreskin of the penis may be one of the most important sites for tactile stimulation during sex. One possibility is that the reason that circumcision can improve ejaculation control is reduced penile sensitivity via removing the part of the foreskin. In addition, a previous study also found circumcised men to report less sexual pleasure and lower orgasm intensity [60]. In conclusion, we assumed that male circumcision improves erectile function (due to unknown reasons) and ejaculation control (due to reduced sensitivity).

We also looked at differences between men who naturally had different degrees of foreskin covering the glans penis while the penis had or did not have a full erection. Based on the highest sensitivity to tactile stimulation of the foreskin and the difficulty with erection if the penis has excessive tight of the foreskin [52, 59], we expected men with less degree of foreskin covering glans while the penis was erect would have less ejaculatory and erectile problems.

**Material And Methods**

**Participants**

Adult men who lived in Shanghai, China, were recruited to participate in the survey. In total, 2051 participants gave their informed consent and completed the survey. Finally, 1976 participants who were aged from 18 to 50 (\(M = 31.54, SD = 5.27\)) reported that their biological sex at birth was male, that they were only sexually attracted to women, that their sexual identity was straight and that they had a stable sexual partner were included. We wanted to initially focus on straight men with female partners in order
to be able to investigate PE and ED without confounding related to the sexual (dys)function of same-sex attracted men who were in relationships with women, a relatively common occurrence in China [61].

Measures

Demographic Information

Participants were first asked to answer questions regarding their age, assigned sex at birth, sexual identity, and if they had a stable sexual partner or not. The response options for sexual identity were straight, gay, bisexual, asexual, and uncertain. They also answered a question about the sex of the persons they were attracted to with response options men, women, both, neither, and uncertain.

Penile Characteristics

Next, participants were asked to report their penis length and circumference. There was a picture showing the length and circumference of the penis and instructions for participants regarding how to measure the length and circumference of the penis (see Fig. 1; [62]). Questions were “Do you know your penis length (cm) when you have a full erection?” and “Do you know your penis girth or circumference (cm) when you have a full erection?”. The options are “Yes, I know (When this option is selected, a fill-in-the-blank number for length or circumference appears)” and “No, I do not know”. The instruction to measure penile length after erection is “1. You should keep standing and the penis must be level with the ground; 2. Try to reduce the impact of pre-public symphysis fat where public hair grows by starting the measurement as close to the penis as possible; 3. Measure along the upper side of the penis from the bottom to the top.” A corresponding instruction was given for measuring the circumference of the penis. Based on the result of previous studies [63–65], for penile length, we removed values lower than 4 cm and higher than 20 cm. For penile circumference, we assumed that values lower than 8.5 cm must be diameters and changed them to circumference using geometry, and removed values higher than 30 cm.

Then, participants were asked “Has your penis been circumcised?” If they chose “No”, they were asked to answer two questions regarding the degree of the foreskin covering the glans of the penis when they do not have an erection and when they have a full erection. Questions were “To what degree does your foreskin cover your glans penis (the tip of your penis) when you do not have an erection?” and “To what degree does your foreskin cover your glans penis (the tip of your penis) when you have a full erection?”. Figure 1 shows the options indicating the different degrees of the foreskin covering the glans penis. Participants were asked to choose one of the five options. Higher values mean less degree of the foreskin covering the glans of the penis [66].

[Figure 1 Near Here]

International Index of Erectile Function-5 (IIEF-5)
The International Index of Erectile Function-5 (IIEF-5), which was developed from the 15-item version [67], was used to measure erectile dysfunction (ED) [68]. An example item is: “How do you rate your confidence that you could get and keep an erection?”. The sum of the five items was computed so that each item was evaluated on a 5-point Likert scale ranging from 1 to 5 for each participant. In a previous Chinese study, the internal consistency assessed with Cronbach’s $\alpha$ was .790 [69]. The electronic version of IIEF-5 has been found to have excellent internal consistency, excellent test-retest reliability, and convergent validity in Western samples [70]. Cronbach’s $\alpha$ was .784 for these items in the present study.

There are five categories of ED based on IIEF-5 scores: Severe (5–7), moderate (8–11), mild to moderate (12–16), mild (17–21), and no ED (22–25) [67].

**Checklist for Early Ejaculation Symptoms (CHEES)**

The 5-item diagnostic tool Checklist for Early Ejaculation Symptoms (CHEES), which was developed from three earlier ejaculation diagnostic tools and has improved validity, was used to measure the ejaculatory function of the participants. This measure has been proven to perform well in differentiating men with and without PE in a Western population sample (AUC = 0.98) [71] and to have good internal reliability of .760 [72]. It has not previously been used with Chinese samples. Therefore, we first translated the scale into a Chinese version using translation software. This version was then modified by native Chinese-speaking sex researchers with Ph.D. students. An example item is: “Over the past six months, was your control over ejaculation during sexual intercourse?” The sum of the five items was computed in which each item was evaluated on a 5-point Likert scale ranging from 1 to 5. In the present study, Cronbach’s $\alpha$ was .776.

A score ranging from 21 to 25 is strongly indicative of fulfilling diagnostic criteria for premature ejaculation (PE). A score ranging from 17 to 20 is indicative of PE. A score ranging from 5 to 16 suggests a low probability of PE. A score of five means the latency time is less than 1 minute on the final question which is a prerequisite in order to strictly comply with the updated DSM-5 [73] and ISSM criteria for premature ejaculation [74].

**Procedure**

The questionnaire was created on two Chinese survey platforms: WJX (https://www.wjx.cn) and CREDAMO (https://www.credamo.com).

On both platforms, an invitation link to the questionnaire was sent to the potential participants who were adult men 18–50 years old and currently living in Shanghai. (https://www.wjx.cn/vj/reLdx3e.aspx; https://www.credamo.com/survey.html#/share/a3a55918c4d245b5b1486dd24cc23db0). The potential participants who were interested in participating could click the survey link. After the potential participants clicked the link, they would read the consent form online, and then decide whether they wanted to participate in the study or not and click the "Yes, I agree to participate (and confirm that I am eligible for this study).” in case they did. Only participants who were over 18 years of age, male, Chinese,
and had a regular sexual partner were asked to participate. The present study was reviewed and approved by the Institutional Review Board. Each participant responding on WJX was paid from 4 to 7 RMB for their participation while each participant responding on CREDAMO was paid 12.5 RMB for their participation in line with the internal processes of the two platforms for a questionnaire of this length. Finally, there are 1055 responses from WJX and 996 responses from CREDAMO.

Participants from CREDAMO had higher age ($t(1974) = 6.394, p < .001$) than participants from WJX. For this reason and also because age was related to the sexual dysfunction variables, we included these variables as covariates in the regression analyses. We also investigated the stability of the associations between the sexual dysfunction variables and the other variables between the two platforms. The confidence intervals of correlations between the correlation between age and the Checklist for Early Ejaculation Symptoms (CHEES), the correlation between age and penile circumference, the correlation between CHEES and penile length, the correlation between CHEES and penile circumference, the correlation between penile length and circumference did not overlap. All the other correlations’ confidence intervals overlapped between the two platforms.

**Statistical Analyses**

We used SPSS 25.0 to conduct the data analyses.

We conducted bivariate Pearson correlation analyses to explore the relationships between age, penile length, penile circumference, erectile function, and ejaculatory function.

Then, we split the data by the median age of 31 into a younger group (aged 31 or younger than 31; $n = 1029$) and an older group (older than 31; $n = 947$). We conducted $t$-test analyses to investigate the differences in penile length, penile circumference, erectile function, and ejaculatory function between the two age groups.

We repeated the bivariate Pearson correlation analyses to explore the relationship between age, penile length, penile circumference, erectile functions, and ejaculatory functions in the two age groups.

We also conducted bivariate correlation analyses with Confidence Intervals to explore whether there were differences in the correlations between age, penile length, penile circumference, erectile function, and ejaculatory function between the two age groups.

We also conducted bivariate correlation analyses with Confidence Intervals to explore whether there were differences in the correlations between age, penile length, penile circumference, erectile function, and ejaculatory function, between participants from CREDAMO and WJX.

Next, we conducted a series of linear regression analyses to explore if the penile length and circumference had associations with ejaculatory and erectile function also after controlling for confounding factors.
We also conducted a \( t \)-test to investigate differences in ejaculatory and erectile function between whether the penis was circumcised or not.

Finally, we conducted one-way ANOVAs to investigate the difference in the ejaculatory and erectile function between the different degrees of the penis being covered by the foreskin when the penis has a full erection or not.

**Results**

Table 1 shows the prevalence of PE and ED. There were 44 (2.3%) participants whose scores were (strongly) indicative of PE. There were eight (0.4%) participants with likely moderate ED, 98 (5.0%) participants with mild to moderate ED, and 546 (27.6%) participants with mild ED.

<table>
<thead>
<tr>
<th>PE</th>
<th>n</th>
<th>%</th>
<th>ED</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>8</td>
<td>0.4</td>
<td>Mild to Moderate</td>
<td>95</td>
<td>5.0</td>
</tr>
<tr>
<td>Strongly Indicative</td>
<td>9</td>
<td>0.5</td>
<td>Mild</td>
<td>546</td>
<td>27.6</td>
</tr>
<tr>
<td>Indicative</td>
<td>35</td>
<td>1.8</td>
<td>No ED</td>
<td>1324</td>
<td>67.0</td>
</tr>
<tr>
<td>Low Probability</td>
<td>1932</td>
<td>97.8</td>
<td>No ED</td>
<td>1324</td>
<td>67.0</td>
</tr>
</tbody>
</table>

*Note.* PE = Premature Ejaculation; ED = Erectile Disorder. The Checklist for Early Ejaculation Symptoms (CHEES) was used to measure the ejaculatory function of the participants. A score ranging from 21 to 25 is strongly indicative of fulfilling the diagnostic criteria for PE. A score ranging from 17 to 20 is indicative of PE. A score ranging from 5 to 16 suggests a low probability of PE. Erectile function was measured by the International Index of Erectile Function-5 (IIEF-5). There are five categories of ED based on IIEF-5 scores: Severe (5–7), moderate (8–11), mild to moderate (12–16), mild (17–21), and no ED (22–25).

Table 2 shows descriptive statistics and the results of correlation analyses between age, penile length, penile circumference, and ejaculatory and erectile function. First, there was a strong positive association between ejaculatory and erectile problems. Then, the result showed that older men reported less of both ejaculatory and erectile problems. Penile length \( (M = 14.49, SD = 2.22; Min = 5 \text{ cm}, Max = 20 \text{ cm}) \) and circumference \( (M = 15.85, SD = 5.42; Min = 4.7 \text{ cm}, Max = 30 \text{ cm}) \) were positively associated but the association was not particularly strong. Importantly, having a longer penis was associated with less of both ejaculatory and erectile problems while higher penile circumference was only associated with less ejaculatory problems.
Table 2

Correlations between Age, Penile Length, Penile Circumference, and Premature Ejaculation Problems and Erectile Function.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Ejaculatory Problems (CHEES)</th>
<th>Erectile Function (IIEF-5)</th>
<th>Age</th>
<th>Penile Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEES</td>
<td>1976</td>
<td>9.40</td>
<td>2.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIEF-5</td>
<td>1976</td>
<td>21.83</td>
<td>2.59</td>
<td>-0.580**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1976</td>
<td>31.54</td>
<td>5.27</td>
<td>-0.076**</td>
<td>0.056*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penile Length</td>
<td>1085</td>
<td>14.49</td>
<td>2.22</td>
<td>-0.201**</td>
<td>0.117**</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Penile Circumference</td>
<td>663</td>
<td>15.85</td>
<td>5.42</td>
<td>-0.222**</td>
<td>0.061</td>
<td>0.217**</td>
<td>0.233**</td>
</tr>
</tbody>
</table>

Note. Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems. Penile length means the penile length when the penis has a full erection. Penile circumference means the penile circumference when the penis has a full erection. *p < .05, **p < .01.

Figure 2 shows the mean scores of CHEES and IIEF-5 in different age groups which indicated erectile and ejaculatory problems decreased and then increased with age.

Table 3 shows the result of the t-test analyses which indicated that the older group has less ejaculatory and erectile problems and a higher penile circumference than the younger group.

Table 4 shows the result of correlation analyses between age, penile length, penile circumference, and ejaculatory and erectile function in the younger and older groups separately. In the younger group, higher age was associated with less ejaculatory and erectile problems. Longer penile length was associated with less ejaculatory and erectile problems. In the older group, higher age was associated with more ejaculatory and erectile problems. Longer penile length was also associated with less ejaculatory and erectile problems. Higher penile circumference was associated with less ejaculatory problems.

We also investigated the stability of the associations between the sexual dysfunction variables and the other variables between the two age groups. The confidence intervals of correlations between age and CHEES, age and IIEF-5, as well as CHEES and penile circumference did not overlap. All the other correlations’ confidence intervals overlapped between the two age groups.
Table 3
Descriptive Statistics by Age Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEES</td>
<td>Younger</td>
<td>947</td>
<td>9.71</td>
<td>2.82</td>
<td>5.159</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Older</td>
<td>1029</td>
<td>9.06</td>
<td>2.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIEF-5</td>
<td>Younger</td>
<td>947</td>
<td>21.60</td>
<td>2.70</td>
<td>-4.281</td>
<td>.001</td>
</tr>
<tr>
<td>Penile Length</td>
<td>Older</td>
<td>1029</td>
<td>22.09</td>
<td>2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penile Circumference</td>
<td>Younger</td>
<td>502</td>
<td>14.39</td>
<td>2.19</td>
<td>-1.652</td>
<td>.099</td>
</tr>
<tr>
<td></td>
<td>Older</td>
<td>583</td>
<td>14.61</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Younger</td>
<td>351</td>
<td>14.29</td>
<td>4.35</td>
<td>-7.238</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Older</td>
<td>312</td>
<td>17.23</td>
<td>5.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems. Penile length means the penile length when the penis has a full erection. Penile circumference means the penile circumference when the penis has a full erection. The younger and older groups were split by the median age of 31. Participants aged 31 or younger were defined as younger. Participants older than 31 were older.
Table 4  
*Correlations between Age, Penile Length, Penile Girth, Ejaculatory Problem and Erectile Function in Younger and Older Group.*

<table>
<thead>
<tr>
<th></th>
<th>Ejaculatory Problems (CHEES)</th>
<th>Erectile Function (IIEF-5)</th>
<th>Age</th>
<th>Penile Length</th>
<th>Penile Girth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 947</td>
<td>n = 947</td>
<td>n = 502</td>
<td>n = 351</td>
<td></td>
</tr>
<tr>
<td>CHEES</td>
<td>-</td>
<td>-.572**</td>
<td>.164**</td>
<td>-.270**</td>
<td>-.312**</td>
</tr>
<tr>
<td>IIEF-5</td>
<td>n = 1029</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.578**</td>
<td>-</td>
<td>-.169**</td>
<td>.130**</td>
<td>.099</td>
</tr>
<tr>
<td>Age</td>
<td>n = 1029</td>
<td>.113**</td>
<td></td>
<td>-.114*</td>
<td>.001</td>
</tr>
<tr>
<td>Penile Length</td>
<td>n = 583</td>
<td>.101*</td>
<td>.016</td>
<td>-</td>
<td>.229**</td>
</tr>
<tr>
<td>Penile Girth</td>
<td>n = 312</td>
<td>-.004</td>
<td>-.008</td>
<td>.018</td>
<td>.184**</td>
</tr>
</tbody>
</table>

*Note.* Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems. Penile length means the penile length when the penis has a full erection. Penile girth means the penile circumference when the penis has a full erection. Below diagonals are the correlations in the younger group. Above diagonals are the correlations in the older group. *p < .05, **p < .01.

Considering the complex effects of age on the relationship between penis size and sexual function, we conducted linear regression analyses between penile size and sexual dysfunction controlling for age. Table 5 shows the result of linear regression analyses between penile length, penile circumference and ejaculatory function before ($R^2 = .093, F(2,637) = 33.751, p < .001$) and after ($R^2 = .101, F(3,636) = 25.023, p < .001$) controlling for age, also for erectile function before ($R^2 = .029, F(2,637) = 10.65, p < .001$) and after ($R^2 = .032, F(3,636) = 7.943, p < .001$) controlling for age. The results showed that longer penile length was associated with less ejaculatory and erectile problems after controlling age. Higher penile circumference was only associated with less ejaculatory problems after controlling age.
Table 5
Linear Regression Analyses between Penile Length, Penile Girth and Ejaculatory Problems and Erectile Function before and after Controlling for Age.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Controlled For</th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penile Length</td>
<td>-</td>
<td></td>
<td>-.264</td>
<td>-.209</td>
<td>-5.404</td>
<td>0</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-.263</td>
<td>-.208</td>
<td>-5.4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Penile Girth</td>
<td>-</td>
<td>-.09</td>
<td>-.184</td>
<td>-4.756</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-.079</td>
<td>-.162</td>
<td>-4.109</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

IIEF-5

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Controlled For</th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penile Length</td>
<td>-</td>
<td>.198</td>
<td>.173</td>
<td>4.304</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>.197</td>
<td>.172</td>
<td>4.291</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Penile Girth</td>
<td>-</td>
<td>.011</td>
<td>.025</td>
<td>0.615</td>
<td>.538</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>.005</td>
<td>.011</td>
<td>0.267</td>
<td>.789</td>
<td></td>
</tr>
</tbody>
</table>

Note. Penile length means the penile length when the penis has a full erection. Penile girth means the penile circumference when the penis has a full erection. The upper rows present the results of regression analyses before controlling for age. The lower rows present the results of regression analyses after controlling for age. Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems.

Table 6 shows the descriptive of the circumcised and uncircumcised groups and the result of t-test analyses. There were 737 (37.3%) participants who had been circumcised and 1239 (62.7%) participants who had not. The t-tests indicated that the circumcised group had less ejaculatory \( (t(1974) = 8.886, p < .001) \) and erectile \( (t(1974) = -4.890, p < .001) \) problems than the uncircumcised group.

Table 6
Descriptive of the Circumcised and Not Circumcised Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>%</th>
<th>CHEES M</th>
<th>CHEES SD</th>
<th>IIEF-5 M</th>
<th>IIEF-5 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-Circumcised</td>
<td>1239</td>
<td>62.7</td>
<td>9.819</td>
<td>2.804</td>
<td>21.608</td>
<td>2.637</td>
</tr>
<tr>
<td>Circumcised</td>
<td>737</td>
<td>37.3</td>
<td>8.684</td>
<td>2.648</td>
<td>22.194</td>
<td>2.473</td>
</tr>
</tbody>
</table>

Note. Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems.
Table 7 shows the descriptive of the groups with different degrees of foreskin covering the glans penis without an erection and with a full erection, and the association between different degrees of foreskin coverage and ejaculatory and erectile problems in uncircumcised participants. Participants who reported that their foreskin covered 100%, 75%, 50%, 25%, 0% of their glans penis when their penis was not erect were 116 (9.4%), 365 (29.5%), 353 (28.5%), 205 (16.5%), 200 (16.1%), respectively. Participants who reported that their foreskin covered 100%, 75%, 50%, 25%, 0% of their glans penis when their penis was fully erect were 6 (0.5%), 41 (3.3%), 75 (6.1%), 124 (10.0%), 993 (80.1%), respectively.

Less foreskin covering the glans penis both without an erection and with a full erection was associated with less of both ejaculatory and erectile problems. There were significant differences between the groups in ejaculatory ($F(4,1234) = 10.252, p < .001$) and erectile ($F(4,1234) = 6.714, p < .001$) problems without an erection. The result of the post hoc tests indicated that participants with glans covering 100% of the foreskin without an erection had more ejaculatory and erectile problems than the other groups. There were no significant differences between the other groups. There were also significant differences between the different degree groups of foreskin covering the glans in ejaculatory ($F(4,1234) = 14.721, p < .001$) and erectile ($F(4,1234) = 22.733, p < .001$) problems with a full erection. The result of the post hoc test indicated that participants with glans covered 0% by the foreskin with a full erection had less ejaculatory and erectile problems than the other group. There were no significant differences between the other groups. Interestingly, the degree of foreskin covering the glans penis without an erection ($r = .029; r = .041$) and with a full erection ($r = .052; r = .006$) was not associated with either penile length or circumference.
Table 7
Descriptive of Groups with Different Degrees of Foreskin Covering the Glans Penis Without an Erection and With a Full Erection in Uncircumcised Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>%</th>
<th>CHEES Mean (SD)</th>
<th>CHEES Correlation</th>
<th>IIEF-5 Mean (SD)</th>
<th>IIEF-5 Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Erection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td>116</td>
<td>9.4</td>
<td>11.371 (3.340)</td>
<td>-.078**</td>
<td>20.586 (3.163)</td>
<td>.147**</td>
</tr>
<tr>
<td>75%</td>
<td>365</td>
<td>29.5</td>
<td>9.666 (2.642)</td>
<td></td>
<td>21.471 (2.516)</td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>353</td>
<td>28.5</td>
<td>9.586 (2.547)</td>
<td></td>
<td>21.674 (2.460)</td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>205</td>
<td>16.5</td>
<td>9.781 (2.718)</td>
<td></td>
<td>21.893 (2.700)</td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>200</td>
<td>16.1</td>
<td>9.65 (3.011)</td>
<td></td>
<td>22.04 (2.610)</td>
<td></td>
</tr>
<tr>
<td>Full Erection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td>6</td>
<td>0.5</td>
<td>9.167 (1.602)</td>
<td>-.195**</td>
<td>20.833 (2.317)</td>
<td>.225**</td>
</tr>
<tr>
<td>75%</td>
<td>41</td>
<td>3.3</td>
<td>11.902 (3.680)</td>
<td></td>
<td>19.512 (3.809)</td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>75</td>
<td>6.1</td>
<td>11.08 (3.083)</td>
<td></td>
<td>20.6 (2.666)</td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>124</td>
<td>10.0</td>
<td>10.573 (2.889)</td>
<td></td>
<td>20.274 (3.309)</td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>993</td>
<td>80.1</td>
<td>9.548 (2.657)</td>
<td></td>
<td>21.942 (2.363)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems. 100% means the foreskin completely covers the glans, and 0% means the foreskin does not cover the glans at all. The smaller the ratio, the less the foreskin covers the glans. **p < .01.

Discussion

The present study investigated the associations between age, anatomical characteristics of the penis, premature ejaculation (PE), and erectile dysfunction (ED).

The average self-reported erect penis was 14.5cm long. This is slightly shorter than the 16.8cm reported for a European sample [63], but similar to what has been reported for a US sample (14.2cm) [64] and other Asian samples (13.0cm) [65]. The mean erect circumference was 12.2cm which is higher than in the above-mentioned Western samples [63, 64] and Asian samples [65] which suggested that the mean erect circumference was approximately 11.5cm. However, the measurement method, social desirability on the part of the reporting man, and the presence of fat tissue can impact the accuracy of the outcomes of penile size measurement [75]. For example, the instruction of the present study instructed reduced the
participants to keep standing and keep the penis level with the ground while other studies have not done so. Having a longer penis was associated with also having a penis with greater circumference, which has also been found in previous research [47]. However, the correlation between length and circumference was not very strong.

Men with a shorter penis reported more ejaculatory and erectile problems in the study. It has previously been reported that men with a shorter penis would suffer from more dissatisfaction and anxiety about their penis size [33]. The dissatisfaction and anxiety about penis size can trigger worry and shame regarding body image and sexual performance during sex [34], even body dysmorphic disorder [34]. The autonomous nervous system contains sympathetic and parasympathetic parts. The balance and timing of the sympathetic and parasympathetic nervous systems are crucial for a well-functioning male sexual response [15]. Excess anxiety about the body and performance during sex can trigger sympathetic overactivity which might inhibit erection and facilitate ejaculation. This may result in insufficient erection and early ejaculation [34, 38, 39]. Having a longer erect penis was associated with less erectile problems in this study. However, erect penile circumference seems to not have an effect on erection which was consistent with previous research [39, 47].

For younger men (younger than or aged 31 years), increasing age had a positive effect on ejaculatory and erectile function. For older men (older than 31 years), increasing age had a negative effect on ejaculatory and erectile function. We assume that the underlying mechanism may be that in men aged 31 years or younger, psychological factors (i.e., less sexual performance anxiety with increased sexual experience) positively affect sexual function with increased age. However, in men over 31, biological factors (i.e., cardiovascular disease, sex hormone level decline) would start having a negative impact on at least erectile function overwhelming the benefits from sexual experience. It is less clear why men in the older group would have more ejaculatory problems when getting older. We assumed the underlying mechanism may be that in men over 31, the physical condition would decrease because the cardiovascular disease risk arises and sex hormone level decline. Sexual intercourse is most physically demanding for lumbar flexion in men [76]. They would experience more physical problems during sexual intercourse (i.e., exhaustion and musculoskeletal pain) because of poor physical condition compared with younger men [77]. Exhaustion and musculoskeletal pain might lead to an early and more sympathetic activity which could lower their ejaculation threshold and early activate the ejaculatory reflex.

The results indicated that being circumcised had a positive effect on sexual function. Specifically, compared to uncircumcised men, circumcised men had fewer ejaculatory problems. These results were consistent with a previous study conducted in China [57] and inconsistent with recent reviews [53, 54]. We suggest that the underlying mechanism of the positive effect of male circumcision on sexual function may be that the part of the foreskin, which was the most sensitive site of the penis to tactile stimulation during sex [59], was removed. In addition, because of the exposure of the skin of the glans penis to the air and friction with the underpants could further reduce the sensitivity of the glans penis after circumcision. Therefore, circumcised men would have better ejaculation control because of reduced penile sensitivity. Surprisingly, we also found that circumcised men had less erectile problems. The main reason why men
in China get circumcised is due to medical reasons (i.e., phimosis) [57]. We assumed that the reason might be the tight foreskin of the penis glans (i.e., phimosis) would disturb the erection which in turn leads to an insufficient erection in some cases. Circumcision that overall or partial removal of the foreskin glans would reduce the effect and consequently reduce the erectile problems.

Interestingly, we also found that uncircumcised men with less foreskin covering the glans penis had less of both ejaculatory and erectile problems. This is the first evidence supporting that the foreskin covering the glans has an effect on sexual function. The underlying mechanism of this link also may be the foreskin's sensitivity to tactile stimulation during sex [59]. The glans penis having less foreskin may be less sensitive during sex and lead to better ejaculation function. As above, less foreskin of the penis glans would have less tightness during erection which would lead to less erectile problems.

Men with more erectile problems also had more ejaculatory problems which was in line with the prior study [13, 14, 78]. Men with erectile problems have less self-confidence in having a sufficient erection allowing penetration. Then, this lower self-confidence will lead to excessive worry and anxiety regarding the penis size while erection as well as sexual performance [23, 79]. This excessive anxiety will disturb the parasympathetic activity to facilitate erection and earlier results in an overactive sympathetic nervous system [40–42] triggering a worse imbalance of autonomic nervous activity which may also be a cause of poorer ejaculatory function in men. In this way, ED symptoms can have a positive association with PE symptoms. However, further studies are needed to understand the details of this process.

The result indicated men of an older age would have a thicker erect penis which was in line with a prior study [80]. However, a prior study found a weekly negative correlation between age and flaccid circumference [81]. In addition, some studies indicated age was not correlated with penile length and circumference [82, 83]. It is possible that the reason for this could be fat tissue accumulating in the penis with increasing age. However, there is little research to investigate the relationship between age and the fat tissues of the penis.

**Limitations and Future Directions**

There were some limitations to the study. First, the penis size was measured by self-reported. There is a potential limitation to the reliability of such self-reports. Future studies should also use objective measurements. Second, we only measured the circumcision status of the men but not the age at which circumcision had been performed. A new review indicated that circumcision performed in infancy, childhood, and adulthood has different psychological effects on men [84]. Future studies should also measure the age of circumcision. Last but not least, the sample's age was relatively young. Future studies should also include more older men.

**Declarations**

**Author Contribution Statement**
Caoyuan Niu: Investigation, Data Collection, Data curation, Methodology, Formal analysis, Writing-original draft, Visualization

Daniel Ventus: Writing-Review & Editing, Visualization

Patrick Jern: Writing-Review & Editing, Visualization.

Pekka Santtila: Conceptualization, Supervision, Writing-Review & Editing

Funding

The original data collections were funded by an internal NYU Shanghai grant to the last author.

Ethical Approval

This study had approved by the NYU Shanghai IRB. Informed consent will be obtained from subjects, but no signed consent form will be used. The potential participants will read the consent form online, and then decide whether they will participate in the study or not and click the "yes, I agree to participate (and confirm that I am eligible for this study)." They need not answer any information that identifies them personally.

Competing Interests

The authors declare no competing interests.

Data Availability Statement

The datasets generated during and/or analysed during the current study are available in the OSF repository, [PERSISTENT WEB LINK TO DATASETS].

References


Figures

Figure 1
Note. Upper is the Measurement of the Length and Circumference of the Penis. Below is the option indicating the different degrees of the foreskin covering the glans of the penis.

*International Index of Erectile Function-5 (IIEF-5)*

![Graph showing CHEES and IIEF-5 scores across different age groups.](image)

**Figure 2**

*Note.* Both CHEES and IIEF-5 have a range of 5-25. Higher values of CHEES suggest more ejaculatory problems. Higher values of IIEF-5 suggest less erectile problems.